3.1 average and instantaneous velocity 2014-10-01 day 26

Which of the following is true?

1) Average speed is always greater than (or equal to) average velocity.

2) Average velocity is always greater than (or equal to) average speed.

3) It depends on each situation.

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winner III

a) give me a situation where average ~~speed~~ is greater than average velocity.

Also b) give me a situation where average velocity is greater than average speed.

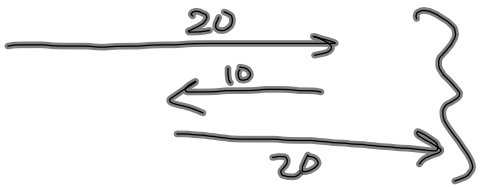
if you voted non-3, give a reason/argument.

3.1 average and instantaneous velocity 2014-10-01 day 26

Winner III

a) give me a situation where average speed is greater than average velocity.

distance/time vs displacement/time



total displacement
[where I end - where I start]
= 30 m

total distance
[all the steps I traveled]
= 20+10+20 = 50

average speed = total distance / time endured

Situation 2

I go backwards 10 mi. in 10 hrs.

avg velocity = −1 mph
avg speed = 1 mph

T or W:
Avg speed is always non-negative.

True because distance is always non-negative.

displacement is negative, positive, or zero.

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winner III

Also b) give me a situation where average velocity is greater than average speed.

3.1 average and instantaneous velocity 2014-10-01 day 26

Average velocity = $\frac{\text{total displacement}}{\text{time endured}}$

displacement: → determined by how I measure
* units
- distance
* direction
- positive or negative
- convention
→ requires a start "place" and an ending place

slope formula
difference quotient
$\frac{s(\text{end}) - s(\text{beginning})}{\text{end time} - \text{beginning time}}$

→ VELOCITY OVER AN INTERVAL

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instantaneous velocity - glance at the speedometer

→ velocity AT A POINT

→ challenge is that the idea of velocity is a "2 point" idea

idea 1: approximate instantaneous velocity with average velocity over a narrow relevant interval.

t	1	3	5
s(t)	0	4	14

approx inst. vel at $t=4$

$\frac{s(5)-s(3)}{5-3}$ $\frac{14-4}{2}=5$

approx inst vel = 2

idea 2: take the limit of average velocity as the "narrow-ness" shrinks to 0

→ implication

I have a f^n: $s(t)$ that tells me as many values as "I need"

inst vel at $t=a$ is $\lim_{t\to a} \frac{s(t)-s(a)}{t-a}$

avg velocity

idea 3 "geometric" idea

on a graph, the instantaneous velocity will be the slope of the tangent line, (to the curve at that single point of interest)

tangent line: * unique * most closely matches the curve at that point. * "near" my point, touches the curve in 1 pt

window

$x: [-5, 5]$

$y: [0, 25]$

$y_1 = x^2$

interested in $x=2, y=4$

graph $y=2x$

inst. vel. at $t=3$

draw tangent

eqn of tangent line

$y = 4x - 4$

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$s(t) = 2t$

$s(a) = 2a$

inst vel at $t = a$: $\lim_{t \to a} \frac{s(t) - s(a)}{t - a}$

$= \lim_{t \to a} \frac{2t - 2a}{t - a} = \lim_{t \to a} \frac{2(t-a)}{t-a}$

$= \lim_{t \to a} 2 = 2$